Lecture 12: Dynamic Rivalry

Primary references:
Besanko et al, Economics of Strategy, Ch. 10
McAfee, Competitive Solutions, Ch. 6.
Cooperation

- The classic questions of dynamic rivalry center around price competition.
  - Since firms that cut prices steal business from other firms, it is difficult to motivate firms to jointly behave like a single monopolist.
  - Since price wars lower total profits for an industry, there is potentially much to gain from cooperation.
  - We will address this shortly.

- Price competition is only one part of interactions.
- Firms design products, set standards, advertise, complement other firms’ activities, pursue or oppose regulations through lobbying, etc.
Advanced Micro Devices (AMD) lobbied American Airlines to initiate non-stop flights between San Jose, CA and Austin, TX (where AMD has a plant).

- The flights were very popular.
- No horizontal rivalry between the two firms, but there is still tension over schedules, price, etc.

Firms seldom trash each others’ products in ads, as that would harm the entire industry to some extent.
Elements of Cooperation

- Mutual interests.
  - Equitable sharing of value added.
- Punishment
  - Price wars.
  - Holdups.
  - Credibility of deterrents.
- Getting back to a cooperative equilibrium
  - Uncertainty leads to error.
Punishments

- Remember we are in a dynamic environment, so think forward and reason backwards.
- In practice, if a punishment hurts the punisher too much, it will not be used.
  - Though sometimes you can bluff, it is usually not a good idea.
- It turns out, though, that we can use “all in” punishments to learn about the possibility of cooperation.
The Nash Reversion Strategy

- Let there be $N$ identical Bertrand duopolists who repeatedly play the one-stage pricing game and discount the future at rate $\delta$.
- Let marginal costs be constant and capacities be “big,” so that the one-shot version of the game results in zero profits.
- Let cooperation yield monopoly profit $\pi_M$, split evenly among the firms.
- Consider a strategy where a firm cooperates every period until one firm cuts price. After the price cut, the firm prices at marginal cost for every subsequent period.
Equilibrium

- Cooperating forever yields payoff
  \[ \frac{\pi_M}{N} \frac{1}{1 - \delta}. \]

- Cutting price today yields payoff
  \[ \pi_M + 0\left(\frac{\delta}{1 - \delta}\right). \]

- Cooperating yields a higher payoff if
  \[ \delta \geq \frac{N - 1}{N}. \]
Characteristics of the equilibrium

- Cooperation is “easier” with fewer firms (the threshold value of $\delta$ is lower).
- Other strategies are consistent with this equilibrium, too. In particular, it is not necessary to have the “cooperative” outcome involve the monopoly price. Lower prices would work, as well.
- More generally, the strategic variables could be more complex than just price.
  - Recall the coordination game we played early in the course, where we divided up cities among two players. This could easily be construed as a division of territory. A more sophisticated version of it appears in the text. What is different about this from how we played it?
Tit for tat

- The “tit for tat” strategy (think of 2 firms for simplicity) consists of cooperating until your rival cuts price, then pricing at marginal cost until your rival raises price.
  - This does not satisfy subgame perfection (imagine firms asynchronously cooperating and cutting), but...

- Tit for tat has much practical appeal, because it offers the hope of returning to cooperation. If I price cooperatively for two periods, I might be able to reintroduce cooperation if my rival plays tit for tat.

- In 1980, Robert Axelrod organized tournaments where people submitted strategies to play in repeated prisoner’s dilemma games.

- Tit for tat dominated.
Price leadership

- This was observed in competition between John Fairfax and Sons (*Sydney Morning Herald, Sun*) and Rupert Murdoch’s News Limited (*Daily Telegraph, Daily Mirror*).
- Between 1941-74, there were seven price increases.
- In four cases, Fairfax moved first and News Limited followed. In three cases, they changed prices simultaneously.
- In 1975, Fairfax raised price, News Limited did not follow, Fairfax eventually lowered its price back.
  - News Limited made $1.6 million with this move, Fairfax lost $1.3 million.
  - News Limited became the price leader.
- How is the behavior in this episode similar to and different from tit for tat?
“People of the same trade seldom meet together, even for merriment and diversion, but the conversation ends in a conspiracy against the public, or in some contrivance to raise prices,” Adam Smith, *The Wealth of Nations*, 1776.

Collusion is common. If you want to see for yourself, try to buy a foreclosed property on the Athens Clarke County courthouse steps (typically the first Tuesday of the month).

Collusion is illegal in the United States. Penalties are harsh fines and/or jail time. Do not do it.

Having said that, many types of cooperation that are *tacit* (unspoken, not overt) are not illegal. Consult an attorney if you do not know where the line is.

Let’s try to understand what makes cooperation easier or harder by beginning with overt collusion.
Collusion: Who Gets Convicted?

<table>
<thead>
<tr>
<th>Industry</th>
<th>Conviction Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highway and Street Construction</td>
<td>33%</td>
</tr>
<tr>
<td>Electrical Contracting</td>
<td>25%</td>
</tr>
<tr>
<td>Furniture Wholesaling</td>
<td>5%</td>
</tr>
<tr>
<td>Water and Sewer Construction</td>
<td>5%</td>
</tr>
<tr>
<td>Motion Picture Theaters</td>
<td>5%</td>
</tr>
<tr>
<td>Refuse Systems</td>
<td>3%</td>
</tr>
</tbody>
</table>

- Source: Jon Joyce (1989) via McAfee.
- Firms convicted tend to be owner/operator firms.
Collusion: How is it done? Exactly how you would think

- Archer Daniels Midland colluded with several firms producing lysine during the 1990s.
- [http://www.youtube.com/watch?v=DPXTsPS-hyw](http://www.youtube.com/watch?v=DPXTsPS-hyw)
Collusion: Territories

- If a group of buyers all have identical demand for a product, then the optimal monopoly price is the same regardless of how many you are selling to.

- Let’s say there are 10 buyers, each with demand \( q_i = 10 - P \). Total demand is \( Q = 100 - 10P \).

- Inverse demand for a single buyer is \( P = 10 - q_1 \), and for all buyers is \( P = 10 - \frac{Q}{10} \).

- If the marginal cost is \( c < 10 \), the optimal monopoly price is \( P^* = \frac{c + 10}{2} \) when selling to any subset of buyers.

- Hence, assigning sellers to buyers generates the “right” pricing incentives.

- Movie theaters have been known to collude by assigning distributors to theaters, so that each theater buys from only the assigned distributor. The cooperation is entirely tacit in this instance.
When firms cooperate this way, a firm that deviates can do so only by stealing business with price cuts.
Lufthansa employees confessed to fixing passenger and cargo fuel surcharges with British Airways, Korean Air and Air France-KLM during 2000-05.

- The US Department of Justice offers immunity to the first to confess, which apparently influenced Lufthansa.

- It is very difficult for firms to write contracts compensating their employees for illegal activity.

- Who trusts who? Would you trust a price fixer?
To collude, firms need to agree on price...what if the quality is different?

This has been a persistent problem for OPEC. Nigerian heavy sour crude oil is different than “Saudi light.”

Suppose the Saudis believe $2 difference per barrel is appropriate but the Nigerians believe the appropriate number is $3.

Because refineries have different technologies, some buyers will be indifferent with a $2 difference and others will be indifferent with a $3 difference.

OPEC has this problem even though they talk. It would be far harder to execute this complicated coordination is talking is illegal.
If there is a long period of time between sales, it is harder to sustain collusion.
  ▶ It is harder to punish the cheater.
  ▶ Milk producers might have to wait until next year’s school contracts before they can retaliate.

We can reinterpret the discount factor $\delta$, somewhat crudely, as reflecting reaction time. When reaction time is slow, $\delta$ is low.
Sustaining Collusion: Random Demand

- If it is hard to distinguish between a drop in demand and a price cut by your rival (all you see is you sold less), then it is harder to sustain collusion.
- It may be necessary to engage in a price war of some fixed duration.
- Intuitively, the price war deters cheating. The fixed duration enables returning to collusive payoffs.
The Joint Executive Committee (JEC)

- The JEC set market shares for rail shipments from Chicago to East Coast cities prior to the Sherman Antitrust Act of 1890.
- The number one product shipped was grain (73%). Prices for other goods were supposed to reflect grain prices.
- If market shares strayed from the predetermined levels, price wars ensued.
- Robert Porter estimated a model of cartel behavior over 1880-86 and found 10 price wars (1 of every 3 weeks).
Sustaining Collusion: Trading with the government

- The government is harder to buy off, so it is easier to collude against.
- Many price-fixing or bid-rigging conspiracies involve government contracts.
- The large turbine generator case is one example.
The Large Turbine Generator Price Fixing Conspiracy of the 1950s

- GE, Westinghouse and Allis-Chalmers colluded on sales of large turbine generators.
- They allocated sales by having one firm make a “real” bid and having the other firms make phony bids.
- The winner was determined by the phase of the moon.
- This system was far from perfect, as you will see in the case.
- For one thing, this is a random allocation scheme, which is inefficient.
Antiques dealers have been known to run cartels that bid for new pieces.

Typically, one dealer will be designated to “win” the auction at a lowball price.

Afterwards, the dealers get together for a “knockout” auction where the auction revenue is shared by the dealers.

It is relatively straightforward to design a knockout auction to be (approximately) efficient (see McAfee, p. 134).

Side payments are necessary, however, which increases the likelihood of detection.
Antiques dealers have been known to run cartels that bid for new pieces.

Typically, one dealer will be designated to “win” the auction at a lowball price.

Afterwards, the dealers get together for a “knockout” auction where the auction revenue is shared by the dealers.

It is relatively straightforward to design a knockout auction to be (approximately) efficient (see McAfee, p. 134).

Side payments are necessary, however, which increases the likelihood of detection.
Failing and Small Firms

- Firms that are going bankrupt have little to lose in taking risky strategies.
  - During the S&L crisis, unhealthy savings and loans offered huge interest rates to depositors (the banking equivalent of a price cut).

- Small firms have less incentive to maintain cooperation than larger firms. For a firm with share $s$ who can gain the entire market with a price cut, it gets $\pi_M + 0\left(\frac{\delta}{1-\delta}\right)$ by cutting and $\frac{s\pi_M}{1-\delta}$ by maintaining cooperation.
  - It may be optimal to let small firms (who are not going away) grow a bit so their incentives to cut price aggressively are lessened.
Price Fixing and Entry

- Cartelized industries are attractive to entrants.
  - Typically, there is “too much” entry.

- Real estate agents typically earn 6% commissions and do not compete fiercely on price.
  - This is encouraged by the Multiple Listing Service but is essentially just an industry norm.

- Who earns the rents? The barriers to entry are very low to be a realtor, so there are lots of them. But the best agents receive nearly all of the benefits, as they avoid price competition.
Solutions to Tacit Cooperation Problems

- Exclusive Territories.
- Industry Associations.
- Published Price Lists.
- Capturing Regulators.
- Multimarket Contact.
- Multilevel Contact.
Industry Associations

- Provide a basis for cooperation on a number of dimensions.
  - Build-the market advertising.
  - Changes to the regulatory structure.
  - Research on the future direction of the industry.

- They also provide a reason for executives to network with each other. This type of contact makes coordination easier.
Published Price Lists

- These permit firms to see what their rivals are doing.
- The basic idea is to put a list of prices together for all products and make it publicly available.
- When goods are differentiated, it is necessary to put together a substitution matrix identifying which products are good substitutes for one another.
- Who would put the list together?
- Firms can still discount off the price list, of course. If they do it too much, the list will cease to be useful.

Stigler (1971) argued that firms will often “capture” regulators and promote regulations that benefit insiders. A typical effect is that regulations lead to the erection of entry barriers or restrictions on pricing that soften competition.

What do we make of recent regulations of the health care and financial services industries?
Let’s return to the infinite-horizon Bertrand model and consider the case where firms have asymmetric market shares. Let firm 1 have market share $s_1$ and let firm 2 have market share $1 - s_1$. For firm 1, cooperating forever yields payoff

$$s_1 \pi_M \left( \frac{1}{1 - \delta} \right).$$

Cutting price today yields payoff

$$\pi_M + \delta \left( \frac{1}{1 - \delta} \right).$$
Multimarket Contact

- Firm 1 prefers to cooperate if
  \[ \delta \geq 1 - s_1 \]

- Firm 2, which has share \(1 - s_1\), prefers to cooperate if
  \[ \delta \geq s_1 \]

- Hence, cooperation is only possible if
  \[ \delta \geq 1 - \min\{s_1, 1 - s_1\} > \frac{1}{2} \]

- Asymmetric shares make it “more difficult” to cooperate in that there is a higher threshold value of \(\delta\).
Now suppose there are two markets and market shares are reversed in the two markets (firm 1 gets $s_1$ in market A and $s_2$ in market B). For firm 1, cooperating forever yields payoff

$$s_1 \pi_M \left( \frac{1}{1 - \delta} \right) + (1 - s_1) \pi_M \left( \frac{1}{1 - \delta} \right) = \pi_M \left( \frac{1}{1 - \delta} \right).$$

Cutting price today yields payoff

$$2\pi_M + 0\left( \frac{\delta}{1 - \delta} \right).$$

Firm 1 prefers to cooperate if $\delta \geq \frac{1}{2}$ (same for firm 2), back to the original single-market, symmetric-share condition.
The intuition is that firms incentive constraints are *pooled* with multi-market contact.

- Deviating is more costly with more markets.
- The set of sustainable allocations is necessarily no smaller with pooling.
Multimarket Contact: Examples

- In the airline industry, firms compete against other firms in many “markets” simultaneously.
  - Define a market as an origin-destination pair of cities.
  - Delta and American competed against each other in 1150 markets in 2007.

- Ciliberto and Williams (2010) find that firms that have high levels of multi-market contact achieve “near perfect cooperation in setting fares” (i.e. fares internalize business-stealing effects) and that cooperation is increasing in the level of contact when that level is relatively low (the increase tapers off as the level of contact gets high).
Transportation costs are significant in industries where the goods have a low value-to-weight ratio.

- Ready-mix concrete.
- Pulp wood.

The way that sellers quote prices may affect the ability to sustain cooperation.

Under **free on board** pricing, firms sell their goods at the loading dock and the buyers absorb transport charges.

Under **uniform delivered pricing**, the firms absorb the transport costs and sell for a single price to all buyers.
Consider two brick makers located in Ahmadabad and Mumbai.

To compete for the Surat market, Ahmadabad must lower its price to all buyers. This is costly.
Uniform Delivered pricing

- If Mumbai cuts price to Surat buyers, then Ahmadabad need only retaliate surgically.
- This lowers Ahmadabad’s cost of retaliating, making punishment a more potent threat.